STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL | 95-17B

INSTRUCTIONS

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD) **970207**

3. DOCUMENT TITLE
TAG REGISTRY

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

This change provides for an input and output amplitude remapping mechanism to the data before it undergoes 12-bit JPEG DCT compression.

5. REASON FOR RECOMMENDATION
This change request supersedes 95-017A. This change is necessary as part of data pre-processing steps necessary for the 12-bit JPEG. These changes decrease the imagge quality loss produced by the JPEG DCT compression for a given compression.

6. SUBMITTER

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c. ADDRESS *(Include Zip Code)*	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

30.2.3 IOMAPA tagged record extension description. The IOMAPA tagged extension contains the data necessary to perform the output amplitude mapping process for each scan within each image frame. This post-processing is applied after the image data has undergone the data expansion process utilizing the 12 Bit JPEG/DCT algorithm.

The output amplitude mapping function is generally the inverse of the input amplitude mapping function that is performed as a pre-processing step before the data compression process is executed.

Note: An exception to this case is when the output of the compression is scaled by a factor (S2) to change the precision of the output product relative to the input data precision.

The explanation of the input amplitude mapping is included to describe the pre-processing performed before the compression process. The pre-processing steps are shown in Figure B3 and the post-processing steps are shown in figure B4 for mapping methods 1 through 3.

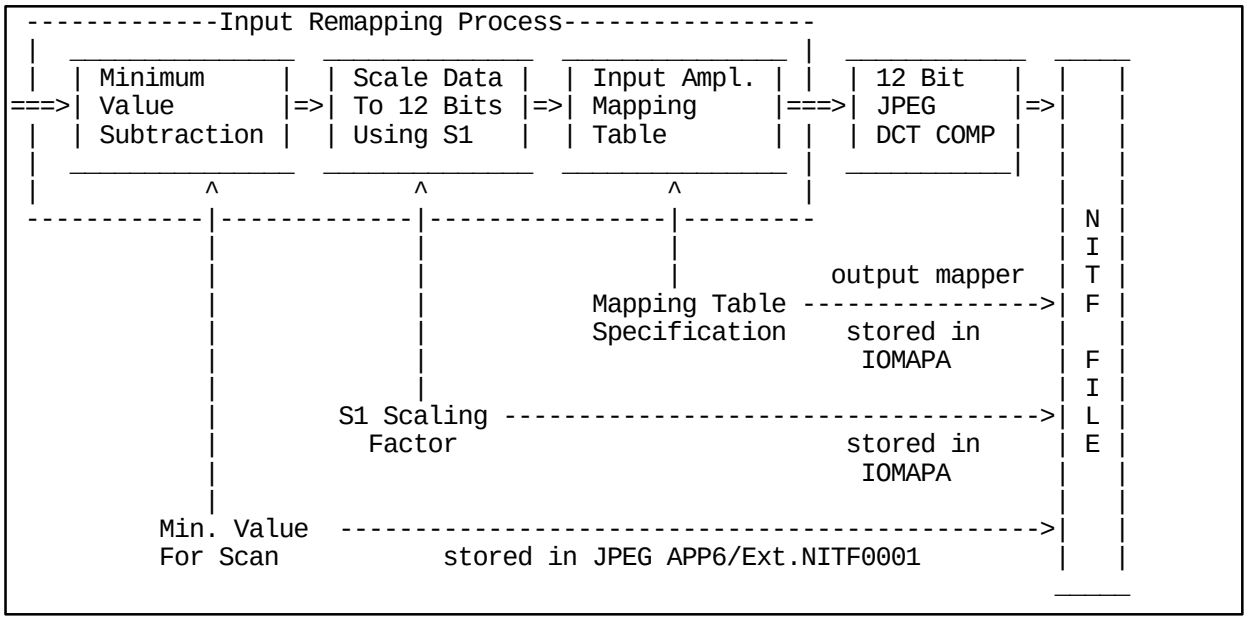


FIGURE B3. Input Amplitude Re-mapping Before Compression (Mapper Type 1 Through 3).

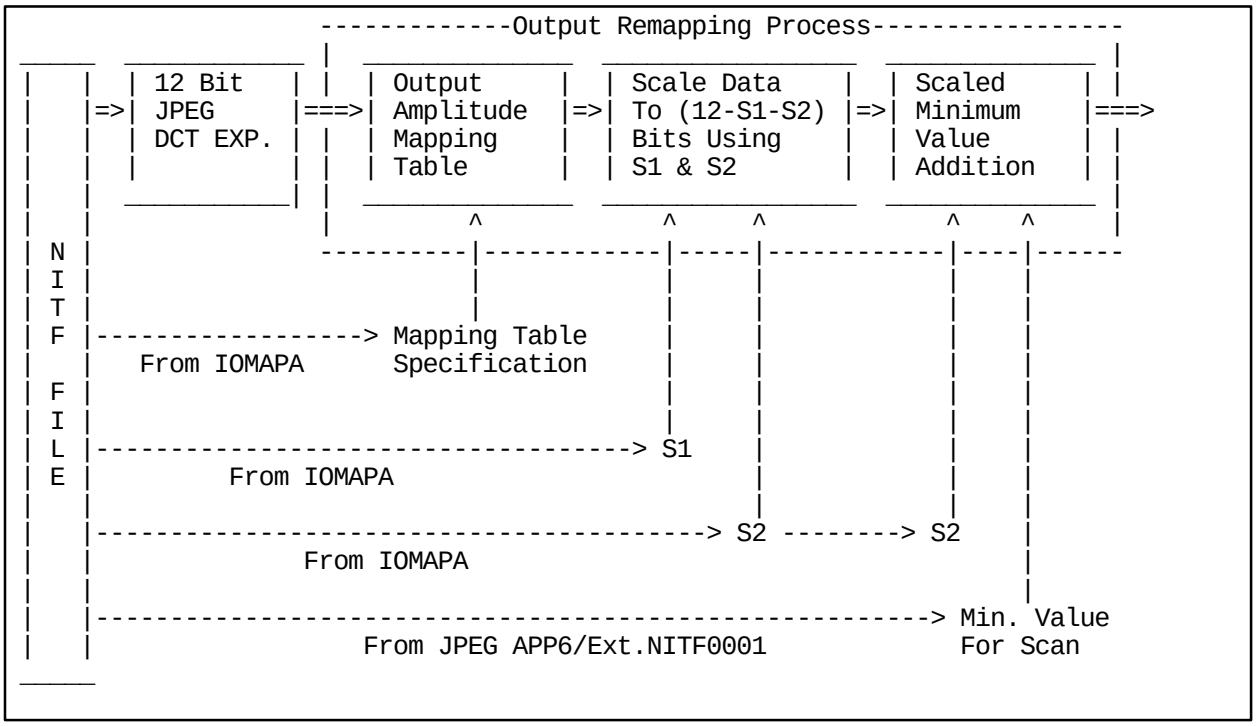


FIGURE B4. Output Amplitude Re-mapping After Expansion (Mapper Type 1 Through 3).

30.2.3.1 Applicable Documents. The JPEG MIL-STD 188-198x contains the description of the APP6/(Extension NITF0001) tag.

30.2.3.2 Format Description and Mapping Method Functions. The IOMAPA data extension is used to transfer the required information needed for the inverse of the input mapping function, i.e., the output amplitude mapping function which is applied to the image data after expansion.

Tables B5 through B8 in paragraph 30.2.3.2.3 define the format for the NITF controlled tagged record extensions bearing the tag of IOMAPA. The IOMAPA tag is meant to be stored in the image sub-header portion of the NITFS file structure. Portions of this tagged record extension are variable depending upon the value of the MAP_SELECT field within the extension.

30.2.3.2.1 Functionality of NITF JPEG/DCT Compressor When Utilizing the IOMAPA Tagged Record Extension. The input amplitude mapping function takes the image data with a known minimum value and performs a three step pre-processing function on each scan contained in the image frame before it is sent to the JPEG/DCT compressor.

The first operation subtracts the minimum pixel intensity for each scan from each pixel in the corresponding scan of the image frame. For example, the minimum value for scan 1 is subtracted from the pixels contained in the scan 1 data block. The minimum value for each scan is stored in the JPEG application segment, APP6/(Extension NITF0001), in order to pass this information to the expander.

The second step in the mapping process is to use a S1 factor to scale the original data up to a 12 bit precision. If the original input data has 9 bit precision, then the S1 scale factor would be set to 3.

The third step in the mapping process is to apply an input mapping function, specified as part of a compression database, to the data. The compressor fills

in the values of the IOMAPA extension from the compression database defining the appropriate output amplitude mapping function to be used by the expander.

In actual practice, the second and third steps can be performed with a scaled lookup table in order to gain efficiency in the implementation of the input mapping process.

If the MAP_SELECT field is equal to 0, then the subtraction of the minimum value from each block shall not be performed. The second and third steps shall also be bypassed because the mapper type 0 is used to turn off the remapping process. However, the data can be scaled with the output mapper after the JPEG expansion to decrease the precision of the data if the S2 factor is non-zero.

30.2.3.2.1.1 Input Amplitude Mapping Method 0. The amplitude mapping method 0 is used to turn off the minimum value subtraction and remapping pre-processing options. The minimum values of the scan is loaded into APP6/(Extension NITF0001), and a non-zero S2 output scaling factor can be loaded into the IOMAPA tag, but the data remains unchanged before it is compressed.

30.2.3.2.1.2 Input Amplitude Mapping Method 1. Table B6 describes the format of the controlled tag extension used to pass the parameters used in the amplitude mapping method 1. The controlled tag extension (method 1) contains a value by value listing or table for the output lookup process. The output lookup table is the inverse mapping of the input lookup table used by the compressor. The input mapping table is contained in a compressor database, but is not needed by the expander and is not included in the IOMAPA tag. The tag also contains the input scale factor value S1, and the output precision scale change value S2.

The input amplitude mapping process which utilizes the input amplitude mapping table shall be defined as:

```
IXX = (IX - MIN) * ISF                  Scale the data to 12 bits after the
                                        subtraction of the minimum value

If IXX is less than 0 then IXX = 0      Clamp the value to the limits for the
                                        input amplitude function.

If IXX is greater than IXMAX then
IXX = IXMAX

IXXX = input_amplitude_map_table[IXX]   Input amplitude mapping table with
                                        starting index of 0 used to remap value

where:

       IX                               Original Pixel Data

       MIN                              Minimum pixel value for image block and
                                        included in the NITF JPEG application
                                        segment APP6/(Extension NITF0001)

       ISF = 2**(S1)                    Scale Factor Exponent where S1
                                        is a data item included in IOMAPA

       IXX                              Scaled Original Pixel Data

       IMAX = 4096

       IXMAX = IMAX - 1                 Maximum Value for Input to Map Table

       IXXX                             Re-mapped Image Pixel Data

       int[]                            Denotes integer truncation
```

Note: The resultant re-mapped value shall then be clamped to ensure that it is greater than or equal to zero and less than or equal to IXMAX,

30.2.3.2.1.3 Input Amplitude Mapping Method 2. Table B7 describes the format of the controlled tag extension used to pass the parameters needed for amplitude mapping method 2. If the MAP_SELECT flag is set to 2, a generalized log mapping shall be utilized as the basis for the input amplitude mapping function. The parameters R, S1, and IMAX shall be utilized to generate the function. The parameters R, S1, and S2 shall be loaded into the IOMAPA extension.

The input amplitude mapping process for when the MAP_SELECT is set to 2 is defined below:

```
IX = Original Pixel Value

IXX = IX - MIN                          Subtract the minimum value for the
                                        image block

If R is not equal to 1.0                Perform log mapping

   IXXX = int[(B * ln(1.0 + A*IXX)) + 0.5]

else

   IXXX = IXX * ISF                     Special case for log mapping if R=1.0


where:

       IX                               Original Image Pixel Data

       IXX                              Image Pixel Data after the minimum value
                                        subtraction

       MIN                              Minimum pixel value for image block and
                                        included in the NITF JPEG application
                                        segment APP6/(Extension NITF0001)

       A = (R-1.0)/IXMID

       B = IXMAX/(ln(1.0+A*ISMAX))

       R                                Log Ratio data item loaded into IOMAPA

       IMAX = 4096                      IMAX shall be 4096 for 12 Bit JPEG/DCT

       IXMAX = IMAX - 1

       ISMAX = (IMAX/ISF)-1             Scaled maximum

       IXMID = (IMAX/(2*ISF)            Scaled mid-point

       ISF = 2**(S1)                    Scale Factor S1

       IXXX                             Re-mapped Image Pixel Data

       int[]                            Denotes integer truncation
```

Note: The resultant re-mapped value IXXX shall then be clamped to ensure that it is greater or equal to zero and less than or equal to IXMAX.

30.2.3.2.1.4 Input Amplitude Mapping Method 3. Table B8 describes the format of the controlled tag extension used to pass the parameters for amplitude mapping method 3. Mapping method 3 uses a 3 segment polynomial mapping process, where each interval is described by a fifth order polynomial. The starting point for each interval and a set of six coefficients defining the polynomial for each segment shall be database items. The coefficients stored in the IOMAPA tag are different from the ones used in the input mapping process. The coefficients stored in the tag usually reflect the inverse mapping characteristics of the input mapper coefficients. The input mapper coefficients are stored in a compressor database, but are not needed by the expander and are not included in the IOMAPA tag.

If the MAP_SELECT flag is set to the value 3, the following segmented polynomial mapping shall be utilized for each pixel before the 12 Bit JPEG/DCT compression process.

```
IX = Original Pixel Value

IXX = IX - MIN                    Subtract the minimum value for the
                                  image block

IXXX = IXX * ISF                  Shifted input value IXX is scaled by ISF


The scaled original pixel (IXXX) value shall determine which
segment of the polynomial function shall be utilized.

Segment (J) shall be defined as

      XIB(J-1) <= IXXX < XIB(J)      For J = 1, 2, and 3

where
      XIB(J) are segment bounds
      XIB(0) = 0 and XIB(3) = 4096
      XIB(1) and XIB(2) are contained in a compression database
```

The scaled input pixel value (IXXX) shall be mapped using the coefficients (ai) for the appropriate polynomial segment as defined above. These coefficients are stored in a compressor database and are not included in the IOMAPA tag. Output coefficients, which perform the inverse operation of the (ai)'s, are included in the IOMAPA tag.

The output mapping segment bounds correspond to the mapped values of the input segment bounds and are included in the NITF CDE IOMAPA. The two output segment boundaries can be calculated using the a0 input mapping coefficients for the second and third segments, respectively. The simple expressions for the output segment boundaries are due to the IZ term being equal to 0 at the XIB(1) and XIB(2) input mapping segment boundaries.

```
      XOB(1) = int[ a0 + 0.5 ]    where a0 is from the input mapping
                                  coefficients for segment 2

      XOB(2) = int[ a0 + 0.5 ]    where a0 is from the input mapping
                                  coefficients for segment 3
```

The input mapping expression for the polynomial function is given below:

```
      IZ = IXXX - XIB(J-1)

      IY = int[a0 + a1*IZ + a2*(IZ**2) + a3*(IZ**3)
                  + a4*(IZ**4) + a5*(IZ**5) + 0.5]

where:
```

IX	Original pixel value
IXX	Image Pixel Data after minumum value subtraction
MIN	Minimum pixel value for image block and included in the NITF JPEG application segment APP6/(Extension NITF0001)
IXXX	Scaled value to determine segment number
ISF = 2**(S1)	Scale Factor (S1 from IOMAPA)
a0, a1, a2, ..., a5	6 Input Mapper Coefficients For Segment J { X(J-1) <= IXXX < X(J) }
XIB(J-1)	Lower Boundary For Input Mapper Segment J
XOB(J-1)	Lower Boundary For Ouput Mapper Segment J
IY	Re-mapped image pixel value
IMAX = 4096	
IXMAX = IMAX - 1 = 4095	
int[]	Denotes integer truncation

Note: The output of the polynomial mapping function (IY) shall be clamped to ensure that it is greater than or equal to zero and less or equal to IXMAX.

30.2.3.2.2 Functionality of NITF JPEG/DCT Expander When Utilizing the IOMAPA Tagged Record Extension. The output amplitude mapping function takes the reconstructed image data from the JPEG expansion process and performs a three step post-processing function on the data unless mapping method 0 is applied. The first step in the remapping process is to apply an output mapping function specified by the IOMAPA extension present in the NITF file. The second operation rescales the data values using the S1 and S2 values. The final operation adds the minimum value extracted from the JPEG APP6/(Extension NITF0001) application segment to each pixel value. If the MAP_SELECT field is equal to 0, then the remapping amplitude function and the addition of the minimum value shall not be performed. Only the S2 factor shall be used to change the precision of the data to (orig_precision-S2) bits.

30.2.3.2.2.1 Output Amplitude Mapping Method 0. The amplitude mapping method 0 code describes to the interpreter of the NITF file that no input or output remapping function or minimum value shift is applied to the data. However, if the S2 field is not equal to zero, the data values shall be scaled by the factor of 2**S2. The output scaled pixel value shall use the following expression:

OX = int[(IY/OSF)]

where:

IY = Pixel Value From JPEG Expander

OSF = 2**(S2)

OX = Output Precision Scaled Pixel Value

30.2.3.2.2.2 Output Amplitude Mapping Method 1. Table B6 describes the format of the controlled tag extension for amplitude mapping method 1.

The IOMAPA tag (method 1) contains a value by value listing or table for the output lookup process. The tag also contains the input scale factor value S1, and the output precision scale change value S2.

The output amplitude mapping process which utilizes the output amplitude mapping table shall be defined as:

```
If IY is less than 0 then IY = 0        Clamp the input to the output amplitude
                                        function.

If IY is greater than IXMAX then
IY = IXMAX

IXX = output_amplitude_map_table[IY]    Virtual array with the values of the
                                        output amplitude mapping table loaded
                                        starting at index 0.

OX = int[(IXX/(ISF*OSF)) + 0.5]
         + int[(MIN/OSF)+0.5]           Scaled Output Data with scaled image
                                        block minimum added.

where:
       IY                               Pixel Data From JPEG Expander

       IMAX = 4096

       IXMAX = IMAX - 1                 Maximum Value for Input to Map Table

       ISF = 2**(S1)                    Scale Factor Exponent where S1
                                        is a data item included in IOMAPA

       OX                               Re-scaled Image Pixel Data

       OSF = 2**(S2)                    Scale Factor Exponent where S2
                                        is a data item included in IOMAPA

       MIN                              Minimum pixel value for image block
                                        extracted from the NITF JPEG application
                                        segment APP6/(Extension NITF0001)

       OMAX = (IMAX/(ISF*OSF))-1        Maximum Value Clamp for Final Output

       int[]                            Denotes integer truncation
```

Note: The resultant output shall then be clamped to ensure that it is greater than or equal to zero and less than or equal to OMAX.

30.2.3.2.2.3 Output Amplitude Mapping Method 2. Table B7 describes the format of the controlled tag extension for amplitude mapping method 2.

If the MAP_SELECT flag is set to 2, a generalized log mapping shall be utilized as the basis for the output amplitude mapping function. The parameters R, S1, S2, and IMAX shall be utilized to generate the function. The parameters R, S1, and S2 shall be extracted from the IOMAPA tag.

The output amplitude mapping process for when the MAP_SELECT set to 2 is defined below:

```
If IY is less than 0 then IY = 0        Clamp the input to the function.
```

```
If IY is greater than IXMAX then
   IY = IXMAX

If R is not equal to 1.0
   IX = int[(((exp(IY/B)-1.0)/A)/OSF) + 0.5]
else
   IX = int[(IY/(ISF*OSF)) + 0.5]

OX = IX + int[(MIN/OSF) + 0.5]        Scaled Output Data with Scaled Image
                                      Block Minimum Added

where:
       IY                             Clamped Pixel Data From JPEG Expander

       R                              Log Ratio data item from IOMAPA Tag

       A = (R-1.0)/IXMID

       B = IXMAX/(ln(1.0+A*ISMAX))

       IXMID = (IMAX/(2*ISF)          Scaled mid-point

       ISMAX = (IMAX/ISF)-1           Scaled maximum

       IMAX = 4096                    IMAX shall be 4096 for 12 Bit JPEG/DCT

       IXMAX = IMAX - 1               Maximum input

       ISF = 2**(S1)                  Scale Factor (S1 from IOMAPA)

       OSF = 2**(S2)                  Scale Factor (S2 from IOMAPA)

       IX                             Re-scaled output mapped pixel
                                      (with minimum still subtracted)

       MIN                            Minimum pixel value for image block and
                                      included in the NITF JPEG application
                                      segment APP6/(Extension NITF0001)

       OX                             Re-scaled Image Pixel Data

       OMAX = (IMAX/(ISF*OSF))-1      Maximum Value for Final Output

       int[]                          Denotes integer truncation

       exp()                          Exponential Function (e**x)
```

Note: The resultant output shall then be clamped to ensure that it is greater than or equal to zero and less than or equal to OMAX.

30.2.3.2.2.4 Output Amplitude Mapping Method 3. Table B8 describes the format of the controlled tag extension for amplitude mapping method 3. Mapping method 3 uses a 3 segment polynomial mapping process where each interval is described by a fifth order polynomial. The break point for each interval and a set of six coefficients defining the polynomial for each segment shall be extracted from the IOMAPA tag.

If the MAP_SELECT flag is set to the value 3, the following segmented polynomial mapping shall be utilized for each pixel output from the expansion process.

The output pixel (IY) from the JPEG/DCT expansion process shall determine which segment of the polynomial function shall be utilized.

Segment (J) shall be defined as

```
      XOB(J-1) <= IY < XOB(J)        For J = 1, 2, and 3
```

where

```
      XOB(J) are output mapper segment bounds
      XOB(0) = 0 and XOB(3) = 4096
      XOB(1) and XOB(2) are extracted from the NITF CDE IOMAPA
```

The output pixel value (IY) shall be mapped using the coefficients (bi) for the appropriate polynomial segment as defined above. The expression for the polynomial function is given below:

```
      If IY is greater than 4095, then IY = 4095.
      If IY is less than 0, then IY = 0.

      IZ = IY - XOB(J-1)

      IXX = int[b0 + b1*IZ + b2*(IZ**2) + b3*(IZ**3)
                  + b4*(IZ**4) + b5*(IZ**5) + 0.5]
```

Where the coefficients b0 through b5 are included in the NITF CDE IOMAPA.

The output of the polynomial mapping function (IXX) shall be scaled by the following relationship:

```
      IX = int[(IXX/(ISF*OSF)) + 0.5]

      OX = IX + int[(MIN/OSF) + 0.5]
```

where:

```
      IY                            Pixel value from expansion process
                                    (Determines Segment Number Location)

      X(J-1)                        Lower Boundary For Segment J

      b0, b1, b2, ..., b5           6 Output Mapper Coefficients For Segment
J
                                    { X(J-1) <= IY < X(J) }

      IXX                           Intermediate value from polynomial
equation

      IX                            Re-scaled output mapped pixel
                                    (with minimum still subtracted)

      ISF = 2**(S1)                 Scale Factor (S1 from IOMAPA)

      OSF = 2**(S2)                 Scale Factor (S2 from IOMAPA)

      OX                            Re-scaled Image Pixel Data

      MIN                           Minimum pixel value for image block and
                                    extracted from the NITF JPEG application
                                    segment APP6/(Extension NITF0001)

      OMAX = ((IMAX/(ISF*OSF)) - 1)  Final output value clamp
```

```
IMAX = 4096

int[]                          Denotes integer truncation
```

The resultant output (OX) shall then be clamped to ensure that it is greater than or equal to zero and less than or equal to OMAX.

30.2.3.2.3 IOMAPA Tagged Record Extension Format Tables

TABLE B-5. IOMAPA format for mapping method 0.
(R) = Required, (O) = Optional, and (C) = Conditional

Field	Description	Length (bytes)	Value Range	Type
CETAG	Unique Extension Identifier	6	IOMAPA	R
CEL	Length of CEDATA Fields	5	00006	R
BAND_ NUMBER	Band Identifier (Band = 000 for Monochrome or Single Band Imagery)	3	000-999	R
MAP_SELECT	Mapping Method to Apply	1	0	R
S2	Scale Factor 2	2	00-11	R

TABLE B-6. IOMAPA Format for Mapping Method 1.
(R) = Required, (O) = Optional, and (C) = Conditional

Field	Description	Length (bytes)	Value Range	Type
CETAG	Unique Extension Identifier	6	IOMAPA	R
CEL	Length of CEDATA Fields	5	08202	R
BAND_ NUMBER	Band Identifier (Band = 000 for Monochrome or Single Band Imagery)	3	000-999	R
MAP_SELECT	Mapping Method to Apply	1	1	R
TABLE_ID	I/O TABLE USED (See note 2)	2	00-99	O
S1	Scale Factor 1 (See note 3)	2	00-11	R
S2	Scale Factor 2 (See note 4)	2	00-11	R
OUTPUT MAP VALUE 0	First Output Mapping Value	2	(See note 1)	R
….	…….	..	….	…..
OUTPUT MAP VALUE 4095	Last Output Mapping Value	2	(See note 1)	R

Notes:

1. Value is stored in 2 byte unsigned integer format (Most Sign. Byte First). The binary value is limited to be greater than or equal to 0 and less than or equal to 4095.
2. Table_ID is not needed to perform the output mapping function. It is used for diagnostic purposes and can be considered an optional field.
3. The value of S1 is used to scale the input data precision up to 12 bits. For the example of 8 bit input data, the S1 value would be 4.
4. The value of S2 is limited to the range where S2 < (12 - S1). Otherwise, all of the data bits would be destroyed.

TABLE B-7. IOMAPA Format for Mapping Method 2.
(R) = Required, (O) = Optional, and (C) = Conditional

Field	Description	Length (bytes)	Value Range	Type
CETAG	Unique Extension Identifier	6	IOMAPA	R
CEL	Length of CEDATA Fields	5	00016	R
BAND_ NUMBER	Band Identifier (Band = 000 for Monochrome or Single Band Imagery)	3	000-999	R
MAP_SELECT	Mapping Method to Apply	1	2	R
TABLE_ID	I/O TABLE USED (See note 1)	2	00-99	O
S1	Scale Factor 1 (See note 2)	2	00-11	R
S2	Scale Factor 2 (See note 3)	2	00-11	R
R_WHOLE	R Scaling Factor-Whole Part (See note 4)	3	000-999	R
R_FRACTION	R Scaling Factor-Fractional Part (See note 4)	3	000-255	R

Notes:

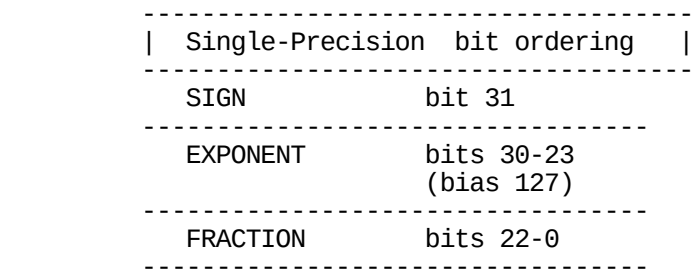
1. Table_ID is not needed to perform the output mapping function. It is used for diagnostic purposes and can be considered an optional field.
2. The value of S1 is used to scale the input data precision up to 12 bits. For the example of 8 bit input data, the S1 value would be 4.
3. The value of S2 is limited to the range where S2 < (12 - S1). Otherwise, all of the data bits would be destroyed.
4. The R values contains two parts, the fractional part and the whole part. The resultant of R is derived by the expression: R = R_WHOLE + (R_FRACTION/256)

TABLE B-8. IOMAPA Format for Mapping Method 3.
(R) = Required, (O) = Optional, and (C) = Conditional

Field	Description	Length (bytes)	Value Range	Type
CETAG	Unique Extension Identifier	6	IOMAPA	R
CEL	Length of CEDATA Fields	5	00091	R
BAND_ NUMBER	Band Identifier (Band = 000 for Monochrome or Single Band Imagery)	3	000-999	R
MAP_SELECT	Mapping Method to Apply	1	3	R
TABLE_ID	I/O TABLE (See note 1)	2	00-99	O
S1	Scale Factor 1 (See note 2)	2	00-11	R
S2	Scale Factor 2 (See note 3)	2	00-11	R
NO_OF_SEGMENTS	Number of Segments	1	3	R
XOB_1	Segment Boundary 1	4	0000-4095	R
XOB_2	Segment Boundary 2	4	0000-4095	R
OUT_B0_1	B0 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B1_1	B1 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B2_1	B2 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B3_1	B3 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B4_1	B4 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B5_1	B5 Coefficient of 1st Segment	4	(See note 4)	R
OUT_B0_2	B0 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B1_2	B1 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B2_2	B2 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B3_2	B3 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B4_2	B4 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B5_2	B5 Coefficient of 2nd Segment	4	(See note 4)	R
OUT_B0_3	B0 Coefficient of 3rd Segment	4	(See note 4)	R
OUT_B1_3	B1 Coefficient of 3rd Segment	4	(See note 4)	R
OUT_B2_3	B2 Coefficient of 3rd Segment	4	(See note 4)	R
OUT_B3_3	B3 Coefficient of 3rd Segment	4	(See note 4)	R
OUT_B4_3	B4 Coefficient of 3rd Segment	4	(See note 4)	R
OUT_B5_3	B5 Coefficient of 3rd Segment	4	(See note 4)	R

Notes:

1. Table_ID is not needed to perform the output mapping function. It is used for diagnostic purposes and can be considered an optional field.
2. The value of S1 is used to scale the input data precision up to 12 bits.
3. The value of S2 is limited to the range where S2 < (12 - S1). Otherwise, all of the data bits would be destroyed.
4. The value is stored in 4 byte IEEE single precision floating point format. Value range is the range available in the standardized 4 byte IEEE single precision floating point format. The 4 bytes are stored in "Network Transmission Order" where the 32 bits are ordered from bit 31 to bit 0 in contiguous order with no byte swapping.



byte 1								byte 2								byte 3	byte 4
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15 ... 8	7 ... 0
S	E	E	E	E	E	E	E	E	f	f	f	f	f	f	f	f .... f	f ... f